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Original Contribution

Training anesthesiology residents in providing anesthesia for awake craniotomy: learning curves and estimate of needed case load☆,☆☆

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Abstract

Study Objective: To measure the learning curves of residents in anesthesiology in providing anesthesia for awake craniotomy, and to estimate the case load needed to achieve a "good-excellent" level of competence.

Design: Prospective study.

Setting: Operating room of a university hospital.

Subjects: 7 volunteer residents in anesthesiology.

Measurements: Residents underwent a dedicated training program of clinical characteristics of anesthesia for awake craniotomy. The program was divided into three tasks: local anesthesia, sedation-analgesia, and intraoperative hemodynamic management. The learning curve for each resident for each task was recorded over 10 procedures. Quantitative assessment of the individual's ability was based on the resident's self-assessment score and the attending anesthesiologist's judgment, and rated by modified 12 mm Likert scale, reported ability score visual analog scale (VAS). This ability VAS score ranged from 1 to 12 (ie, very poor, mild, moderate, sufficient, good, excellent). The number of requests for advice also was recorded (ie, resident requests for practical help and theoretical notions to accomplish the procedures).

Main Results: Each task had a specific learning rate; the number of procedures necessary to achieve "good-excellent" ability with confidence, as determined by the recorded results, were 10 procedures for local anesthesia, 15 to 25 procedures for sedation-analgesia, and 20 to 30 procedures for intraoperative hemodynamic management.

Conclusions: Awake craniotomy is an approach used increasingly in neuroanesthesia. A dedicated training program based on learning specific tasks and building confidence with essential features provides "good-excellent" ability.

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1. Introduction

The introduction of new techniques or procedures in the practice of anesthesia requires specialized training [1,2]. Neuroanesthesia is a well-recognized subspecialty that requires specific knowledge, expertise, and training [3]. There is recent evidence that resection of brain lesions adjacent to speech areas with intraoperative real-time mapping during awake craniotomy allows more aggressive resection while minimizing perioperative morbidity [4,5]. Currently, awake craniotomy is the preferred approach to functional neurosurgery, including deep-brain stimulation for the treatment of Parkinson's disease and, more recently, the treatment of various other conditions, including obesity and severe obsessive compulsive disorders; epilepsy surgery; and any neurosurgical procedures that require intraoperative monitoring of speech and motor function [4–16].

From our experience and review of the literature, we identified three tasks essential to providing anesthesia for awake craniotomy: local anesthesia for scalp nerve blocks, sedation-analgesia, and intraoperative hemodynamic management [17]. A dedicated training program based on these three tasks was developed to train anesthesiology residents.

In this prospective study, we evaluated the learning curve of residents in anesthesiology for each of the three essential tasks needed for anesthesia for awake craniotomy. Evaluation of the learning curve was based on residents' self-assessment and attending anesthesiologist evaluations using a modified Likert scale and by recording the number of requests for advice or assistance. Based on the slope coefficient derived from learning curves, we also aimed to estimate the average number of cases needed to achieve a "good-excellent" level of competence for the related task.

2. Materials and methods

After "Sapienza" University of Rome Institutional Review Board review and approval (study No. 289/11, approved 10/3/2011 by Professor Isidori), 7 anesthesiology residents with at least two years of practice in neuroanesthesia were recruited to the study. Each patient in the study gave written, informed consent to participate. Basic requirements for resident participation in the training program were knowledge of neuroanesthesia principles, accepted practice of general anesthesia for craniotomy, and advanced expertise in airway management, including use of the Laryngeal Mask Airway and fiberoptic intubation [18–21].

2.1. Preliminary training

Residents received a dedicated training session that included formal presentation of the theoretical background, specific aims, needs, and risks related to each of the three tasks: local anesthesia for scalp block, sedation-analgesia, and intraoperative hemodynamic management [22]. The theoretical principles were taught in group discussion format, and ended with individual interviews to ensure that each resident achieved advanced understanding. Practical training was completed in small groups; two to three residents observed the same anesthetic for an awake craniotomy procedure, which included working under the guidance and direction of an experienced attending anesthesiologist during at least 10 procedures. When residents had direct responsibility of managing the procedure, the attending anesthesiologist remained on site to monitor the procedure, provide advice when required, and take over the case if needed.

Local anesthesia was administered during awake craniotomies with the aim of blocking scalp sensory stimuli and was accomplished with a total of 0.5 mL/kg (of patient's body weight) 7.5% ropivacaine for selective blocks of sensory branches of the trigeminal nerve (auricolotemporal, zygomaticotemporal, supraorbital, supratrochlear) and of the greater and lesser occipital nerves. Furthermore, the head holder pin sites and surgical skin incision line also were infiltrated with subcutaneous injection of local anesthetics [23–25].

The sedation-analgesia protocol used at our institution primarily relies on propofol-fentanyl or propofol-remifentanil infusion; droperidol and an α2-receptor agonist are also used when needed [26,27]. Furthermore, this task encompasses aggressive prevention and treatment of postoperative pain. Paracetamol (1 gr x 3/day) was the mainstay of systemic postoperative analgesic therapy. Opioids (morphine or fentanyl) were added in patients with persistent pain or in whom paracetamol was contraindicated [28].

Intraoperative hemodynamic management was used to manipulate the systemic and cerebral hemodynamics so as to guarantee optimal brain perfusion and surgical field conditions [29,30]. This task encompasses the use of various antihypertensive medications to lower arterial blood pressure when needed, including short-acting and long-acting beta blockers (esmolol, metoprolol or labetalol), calcium-channel antagonists (diltiazem), the α1-adrenoceptor antagonist (urapidil), and the α2-receptor agonist (clonidine) [31–34]. The use of nitrates was discouraged because of the related increase in cerebral blood volume and significant brain swelling [35,36]. Ephedrine was considered as a first-choice therapeutic approach for the treatment of bradyarrhythmias and arterial hypotension, while isoprenaline use was indicated in bradyarrhythmias associated with arterial hypertension. Atropine use was discouraged due to related drawbacks such as facilitation of seizures and postoperative delirium [37]. Perioperative tachyarrhythmias may be caused by various pathophysiological mechanisms and treatment should be addressed to the underlying cause, which may include hypovolemia, anemia, pain, or increased sympathetic tone. In the latter case, beta blockers are the preferred drugs [34].

Perioperative monitoring for all patients included continuous three-lead echocardiogram for heart rate and arrhythmias monitoring, invasive arterial catheter for real-